

an analytic function of its arguments? or does the word *analytic* mean *regular*? and what is the meaning of *expressed*? Again, on p. 98: "This transformation of the variables has only involved algebraic processes." The processes in question consist in reverting certain power series; now a power series is an entirely symbolic thing unless we have very simple rules for the law of its coefficients; how can the reversion of a power series in general be regarded as a practicable process likely to aid the effective determination of the integrals of a differential equation? and at any rate it does not seem fair to describe it as an algebraic process. Moreover, apart from such indefiniteness, and passing over such phrases as (p. 24) "where  $t$  is a constant so small that its square may be neglected," there is the question, apparently unconsidered in this book, of how far Lie's propositions can be proved for functions which are not analytic, in regard to which various investigations are already forthcoming.

But we gladly turn from such criticisms to remark again on the merits of the book, choosing two random examples, one of the practical spirit in which it is written, the other of the author's eye for a neat result. On p. 256 the author frankly uses the known theorems as to forces in three dimensions to abbreviate the reduction of the equation of a linear complex. On p. 243 the author arrives at the theorem that Ampère's partial differential equation of the second order is reducible by a contact transformation either to  $s=0$  or to  $rt-s^2=0$ , according as it possesses two distinct systems of intermediary integrals or only two coincident systems. In conclusion, we would express our admiration for the form and printing of the volume.

H. F. B.

#### TECHNOLOGICAL CHEMISTRY.

*The Industrial and Artistic Technology of Paint and Varnish.* By A. H. Sabin, M.S. Pp. vi+372. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 12s. 6d. net.

*Food Inspection and Analysis.* By Albert E. Leach, S.B., Analyst of the Massachusetts State Board of Health. Pp. xiv+787. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1904.) Price 31s. 6d. net.

(1) **THIS** is a gossipy, pleasantly discursive volume, the style of which will be indicated when we remark that the book is prefaced by an extract from Quintilian, and closes with a poetical quotation. It treats, generally in untechnical and even colloquial language, of varnishes and paints, their history, fabrication, and uses. Principles, not formulæ, are usually given by the author; the book is in no sense a collection of recipes.

If there is not much of strictly scientific value in the treatise, there is a good deal which is of practical interest. The chapter upon the protection of metals against corrosion, for instance, may be recommended to the notice of engineers, and also that on the coating of water-pipes. As regards this latter question, the author points out that the essential feature of the "Angus Smith process" has been misapprehended in

modern practice. Dr. Smith's treatment resulted in a varnish or "enamel" of linseed oil and coal-tar pitch being baked on to the cleaned surface of the pipe, the oil oxidising more or less completely during the operation. The modern substitute for this is, too often, a mere dipping of the pipe in crude tar, or in tar diluted with "dead oil." From the wording of the original patent this process may, on a technicality, pass under Angus Smith's name; but our author has no doubt that if the inventor were living he would condemn the whole thing from beginning to end. It is "adulterating his invention and stealing his reputation."

Mr. Sabin describes a process of his own, which has, he tells us, been successfully applied to large pipelines in America, and is in use in the United States Navy for the protection of heavy copper mains. It is evidently based upon a study of the Angus Smith process. It consists in applying to the pipes a thin coating of a mixture of linseed oil and asphaltum, and afterwards heating the pipe to 400° F. until the oil is completely oxidised. The product is said to be a hard, elastic enamel. One result is that, whereas the aforesaid copper mains had formerly an average "life" of about six months, they have now lasted three or four years, and their ultimate durability is not yet determined.

There is some curious lore in the author's historical summary. The connection between electricity and "Berenice with the golden hair," between varnish and the Queen of Cyrene, is a good example of etymological ramifications. One quaint recipe of 1520 is worth quoting:—

"A most excellent varnish for varnishing arquebuses, crossbows, and iron armour: Take of linseed oil two pounds, sandarac one pound, Greek pitch two ounces. Boil the oil, then dissolve in it the other ingredients, and strain through a much-worn linen cloth; and when you wish to use the varnish, scrape and polish the work and heat it in a hot oven, because that is the best place to heat it . . . then lay it on thinly with an instrument of wood, so that you may not burn your fingers, and it will make a beautiful changing colour.

"And if you supplied the place of Greek pitch with naval pitch, I think it would make the work black when you varnished it."

The treatise can be read with profit either by the manufacturer who knows little of chemistry, or by the chemist who wishes to know something of paint and varnish technology.

(2) There is a Madras story of a native woman, who, charged with possessing illicit salt, would offer no defence; wherefore she was about to be mulcted in the sum of one rupee. Before closing the case, however, the magistrate thought he might just as well satisfy himself that the substance really was salt, and forthwith proceeded to taste it. Thereupon the lady raised her voice in a very effective interjection: "Not only," said she, "not only does the sahib fine me one rupee, but lo! he eats the ashes of my dead husband."

Fortunately for magistrates, such appeals to the palate are rarely either necessary or sufficient, nowadays, for disposing of legal cases relating to the identity and purity of foodstuffs. Much more cum-

brous machinery has had to be devised. To summarise and explain this machinery is the aim of the work under notice. In the main it is intended for the food analyst, and the author's idea has been to give this official some information, not only on the subject of food-analysis, but also on various collateral matters with which he is brought into contact. Thus there are sections discussing the equipment of the laboratory, the storage of samples, legal precautions, the duties of the food inspector, and certain processes of food manufacture.

All the ordinary foodstuffs are dealt with, a chapter being allotted to each group of allied products, such as cereals, spices, alcoholic beverages, and so on. The descriptions are written clearly; an excellent selection of the salient facts and the best methods of examination has been made; and to each division an extensive bibliography is appended. Microscope work is a special feature, and the volume is enriched by a series of forty plates, containing about four times as many photomicrographs of the principal vegetable and animal structures met with in the examination of foods.

The chief criticism to offer on the book is that the treatment of so much material in one volume—even one of eight hundred pages—must necessarily be in the nature of a summary. Hence in many instances the information, though sufficient for routine work, is not full enough to be of much value when cases of real difficulty arise.

One notes several examples of careless transcription in looking through the work. On p. 441 the so-called "Koettstorfer's equivalent" for butter-fat is given a maximum value of 241 and a minimum of 253. It might be guessed that these two numbers have been transposed; but on the next page the value of the constant in question is given as 224. The author has, in fact, failed to distinguish between the "equivalent" and the "value" of the saponification experiment. In the table on p. 441 the values of the insoluble acids for oleomargarine are transposed; the specific gravity has no temperature of reference; and a faulty arrangement of the table makes it appear that butter-fat and margarine possess, somehow, a maximum and a minimum temperature; whilst in the data for edible oils and fats on p. 380 the limiting values are again transposed.

Nevertheless, it would be unfair to judge the book by these slips. It contains a large amount of information and, though written more particularly from the American point of view, will be found a useful conspectus of the whole field of food control.

C. SIMMONDS.

#### THE TRANSPIRATION OF PLANTS.

*Die Transpiration der Pflanzen.* Eine Physiologische Monographie von Dr. Alfred Burgerstein, A. O. Universitätsprofessor in Wien. Pp. x+283. (Jena: Gustav Fischer, 1904.) Price 7.50 marks.

THIS book is a classified analysis of the published work on transpiration from the time of Hales onward, with a running criticism by the author, who

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is well known to have attended to the subject for many years.

The amount of contradictory evidence is remarkable. In the case of the earlier experimenters, with more or less faulty methods, this is not surprising; but the same thing strikes one in many modern instances. The question of the amount of transpiration in moist tropical regions, as compared with Europe, is a case in point. Another instance is what the author describes as a "seven years' war" (1884-1891) between Wille and Lundström as to the absorption of water by the aerial parts of plants. Other disputed points are the effect of salt solutions supplied to the transpiring plants, and the influence of varying amounts of CO<sub>2</sub> in the atmosphere; and many other cases might be cited.

The relation of plants to water, though a subject of primary importance, is still to a great extent in the elementary stage of inquiry. A large number of the statements quoted by Burgerstein are little more than disconnected facts, and, in spite of the interesting book he has made of them, they still seem to us to await a somewhat different treatment.

The subject-matter of the book falls into two classes:—(1) the loss of water-vapour considered as physical phenomenon; (2) the biological inquiry into the adaptation of plants to the distribution of water considered as environment. From both points of view transpiration should be considered side by side with assimilation and respiration, and this manner of looking at the subject has not, in our judgment, been kept sufficiently in mind by the author. The point is that the same organs—the stomata—serve for gaseous exchange and for the evaporation of water. Burgerstein discusses at the end of his book the question whether, as some have supposed, transpiration is a necessary evil. This might have been discussed from a broader standpoint, and would have been in place in an earlier chapter. It does not seem necessary to treat the view referred to as entirely false. Plants undoubtedly have to strike a balance between the possession of a free stomatal connection with the atmosphere and the consequent danger of evaporating more water than they can take up from the soil. This compromise includes also the value of the transpiration-stream in supplying minerals to the aerial parts, on which Burgerstein rightly lays stress. All we suggest is that the whole problem, being of a fundamental character, might well have been dealt with more liberally, and been given a place preliminary to the details of transpiration.

A fault in Burgerstein's treatment of transpiration, though a fault difficult to avoid, is that he does not keep before the reader the fact that the condition of the stomata—whether open, half open, or shut—is far and away more important than all the other internal conditions put together. Like the rest of the world, he is well aware of this, but we doubt whether the uninstructed reader would here learn to think of the problem in this way. To take an example, he describes (p. 62) how, when part of the foliage is removed, the remaining leaves transpire more actively than before. Here we want a discussion of the possible effects, direct or indirect, of the operation on the